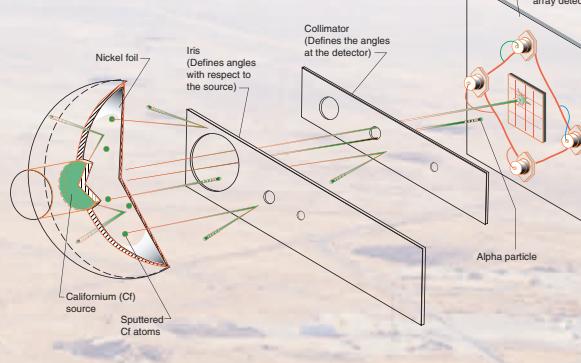


# Contributing to Stockpile Stewardship

## Understanding physics phenomena and reestablishing test readiness

### "Sputtering" Experiments

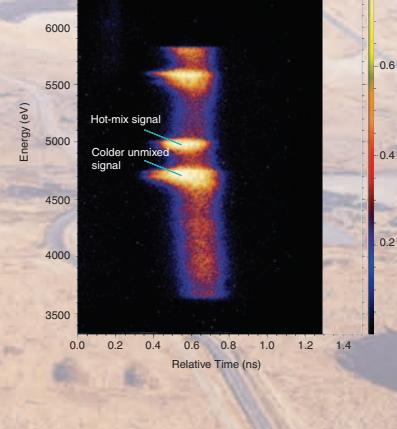
Los Alamos scientists are constructing an apparatus that will measure the yield of particles sputtered (ejected) from a californium source by spontaneous internal fission. This work will help scientists gain a better understanding of fission-fragment processes. Such understanding is important to stockpile stewardship.



**Decay products enter a spherical container (known as the "lobster basket"), where they either stick to a thin (3 millimeters) nickel "catcher" foil attached to the outer edge of the container or are caught within the container. Those that are caught in the assembly undergo further decay and emit alpha particles. Some of these particles travel through a collimator and are recorded by a position-sensitive photodiode detector. The detector measures the alpha-particle activity of the sputtered material on the catcher foil and in the basket, allowing scientists to precisely determine the amount of material desorbed from the californium source.**

### Understanding "Mix"

In thermonuclear-fusion experiments on the Omega laser, Los Alamos scientists are exploring mix, a phenomenon whereby material (impurities) from the shell of an imploding spherical capsule is introduced into the hot, dense plasma produced by the implosion. Mix significantly affects the implosion and subsequent burn and thus changes the nuclear fusion yield from the imploding capsule. Los Alamos scientists are investigating how the shell material reaches the core of the capsule and how much of that material is mixed during the implosion.



This time-dependent spectrum obtained in an experiment at the Omega laser facility shows the history of mixing of capsule material during an implosion. The amplitude (height) of the hot mix signal to the colder unmixed signal provides information about how much mixing occurred and when (time history).

### Understanding Burn History

More than two decades ago, a team of Los Alamos scientists thought about using fusion-generated high-energy gamma rays as a diagnostic to acquire thermonuclear burn-history measurements in experiments at the Nevada Test Site (NTS). Burn history accurately measures the time evolution of the thermonuclear fusion rate. Results from these early tests were encouraging but not definitive. A collaboration that included three original members of the NTS research team recently obtained for the first time unambiguous high-energy gamma-ray signals from the laser-driven fusion of deuterium and tritium (DT) on Omega. A gas-Cerenkov detector (GCD), designed to separate high-energy gamma rays from other background sources, quickly converts gamma rays to optical light. This diagnostic method will be used at the National Ignition Facility as an essential means to understand the detailed physics of thermonuclear burn in an implosion system.



The GCD is inserted into the Omega target chamber where 60 converging laser beams implode a DT target capsule. Gamma rays produced by the DT fusion strike the beryllium converter at the front end of the GCD, producing secondary electrons. The higher-energy electrons enter the gaseous carbon dioxide ( $\text{CO}_2$ ) volume and interact with the  $\text{CO}_2$  molecules. This interaction creates optical Cerenkov light (a bluish, ghostlike emission), which is then collected and sensed by an appropriate detector.

### Test Readiness

Test readiness involves our ability to perform an underground nuclear test at the NTS within 18 months from the time the test would be authorized by the U.S. president. Passing on knowledge from experienced scientists and diagnostics engineers to a new group of scientists and engineers too young to have participated in the last underground test in 1992 is critical. In response to this need, members of the Physics Division are integrating new technology and diagnostic techniques with traditional experience and resurrected equipment in such a way that weapons designers will not notice the difference in test data between a future underground test and one performed 12 years ago.



The Icecap experiment was halted by the nuclear weapons testing moratorium in 1992. Mentors and trainees are given Los Alamos-sponsored tours of the Icecap tower rack. These tours give them a chance to hear detailed descriptions of the Icecap event from the scientists and engineers who had been working on the experiment before it was halted.